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Impurity Diffusion Process for Silicon Semiconductors Is Fast and Precise

The problem: To produce precision silicon semiconductor junctions economically by accelerated fabrication techniques. The present method involves a dopant-rich oxide that diffuses impurity atoms into a silicon wafer for a given time at a given temperature. Because the oxide is grown from the silicon wafer, impurities already in the silicon wafer may act as counterdopants to the desired impurities. Thus the concentration of the dopant in the oxide cannot be controlled. This method is also time consuming.

The solution: A process in which the oxide is deposited rather than grown on the silicon wafer and a controlled concentration of impurity atoms in gaseous form is simultaneously introduced into the reaction. This process is more accurate and requires much less time at elevated temperatures.

How it's done: A silicon dioxide (SiO_2) layer is deposited on the silicon wafer by either steam oxidation or thermal decomposition of CO_2 and SiCl_4 in the presence of hydrogen. A window is cut by photoengraving in the SiO_2 layer in the region where the junction is desired and a second SiO_2 layer is deposited in this region as a gaseous dopant is simultaneously introduced into the reaction. Dopants used

are B_2H_6 (p type), PH_3 (n type), and AsH_3 (p type). The gas is metered into the reaction under much finer control than is possible with liquid or solid impurity sources. A shorter time at elevated temperatures is required and results in less migration of prior diffused impurities within the silicon.

Notes:

1. This invention should be of interest to manufacturers of semiconductor devices.
2. Inquiries concerning this invention may be directed to:

Technology Utilization Officer
Goddard Space Flight Center
Greenbelt, Maryland, 20771
Reference: B65-10300

Patent status: NASA encourages the immediate commercial use of this invention. Inquiries about obtaining rights for its commercial use may be made to NASA, Code AGP, Washington, D.C., 20546.

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(GSFC-397)

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